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ABSTRACT

This paper discusses the efforts of the Department of Mathematics at the United States Coast Guard Academy (USCGA) to determine the degree to which their courses support the published academic outcomes of the institution, and presents the results of a survey of student attitudes toward the academic outcomes. A survey questionnaire was developed and administered to 425 students taking mathematics courses during the spring term of 1997. Factor analysis of the results led to the identification of five outcome factors: problem solving, writing, reading, applied learning, and evaluation. The construct validity of the instrument was also examined. It is concluded that the construction of the survey required the department to examine in detail how its courses supported published USCGA outcomes and provided valuable feedback in the curriculum development process by establishing baseline assessments for each outcome. Three appendixes provide a listing of judgmental categories for attitude toward academic outcomes in mathematics courses, a copy of the survey questionnaire, and statistical tables. (MDM)

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Assessing Academic Outcomes at the United States Coast Guard Academy: the Role of Student Attitudes.[1]

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Assessing Academic Outcomes at the United States Coast Guard Academy: the Role of Student Attitudes[1]

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Abstract

Assessment of academic outcomes is an essential component of curriculum development. The Dean of Academics at the United States Coast Guard Academy has published 10 academic outcomes which describe a broad range of behaviors and attitudes representing an ideal product of the 4-year academic program. This paper discusses the efforts of the Department of Mathematics to determine the degree to which their courses support the published academic outcomes. A survey instrument measuring student attitudes towards the academic outcomes was developed and administered to 425 students taking mathematics courses during the Spring '97 semester. Exploratory common factor and Rasch latent trait analyses were used to examine construct validity. Alpha reliabilities were calculated. The factor analysis resulted in five outcome factors: Problem Solving, Writing, Reading, Applied Learning and Evaluation. The results of the study will be used to illustrate how the Department of Mathematics will establish a baseline assessment of student attitudes towards academic outcomes for each course. Establishing baseline assessments of student attitudes will allow the Department to identify changes in student attitudes which can be used in evaluating the effectiveness of modifications to instructional format and/or curriculum. The study illustrates how student attitudes can be used in the assessment process to provide valuable information for curriculum development.

Introduction

The United States Coast Guard Academy is one of five federal service academies. The student body consists of approximately 850 students from all over the United States, as well as a dozen or so exchange students from countries around the world. The Coast Guard Academy provides the opportunity for students to obtain a Bachelor of Science degree in one of eight majors, in addition to a commission as an Ensign in the United States Coast Guard. As an educational institution, the Coast Guard Academy considers the issues of academic outcomes and the assessment of those outcomes to be very important. Over the last several years the Academic Division has engaged in a great deal of dialogue about the academic program and what graduates should be getting from that program. As a result of this dialogue the Dean has published 10 academic outcomes which define the purpose of the academic program. These outcomes are listed below.

A cadet shall be able to:

1. read and understand a variety of written materials, listen critically to oral arguments, and formulate penetrating questions

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[1] Paper presented at the annual meeting of the Northeastern Educational Research Association, October, 1997, Ellenville, NY.

2. write clear, concise, persuasive and grammatically correct passages on general or professional topics, from a paragraph to several pages in length.

3. apply the basic skills of critical analysis, quantitative reasoning and problem solving to complex tasks in a broad range of contexts.

4. prepare and deliver a well organized and polished oral presentation to a variety of audiences on topics within their fields of competence.

5. gain access to a broad range of information systems and locate desired data reliably.

6. integrate knowledge and information efficiently into a working conceptual framework that lends itself to continued expansion and refinement.

7. show evidence that they (graduates) are capable of honest, realistic, and constructive self-evaluation, that they can devise successful and creative strategies to develop their strengths and correct their weaknesses, and that they demonstrate the intellectual, moral, and physical stamina to follow through.

8. function effectively as a member of a team or working group that is charged with studying a complex problem or a significant policy issue and arriving at a solution or recommendation.

9. comprehend the interrelationship of the diverse social, economic, political, cultural, technological, and environmental forces that shape the world in which the Coast Guard operates.

10. articulate their personal values and those of the Coast Guard and public service in general, recognize conflicts in value systems when they exist, and formulate reasoned arguments to support their resolutions of the conflicts.

These outcomes, by describing a broad range of behaviors and attitudes, represent an ideal product of the 4 year academic program at the Coast Guard Academy. Assuming that these outcomes adequately describe the purpose of the academic program, the question becomes how are these outcomes assessed? Does the academic program at the United States Coast Guard Academy achieve its stated goals? At the start of the 1996-97 academic year the Dean tasked each academic department to investigate possible answers to this question.

The Mathematics Department approached this task by first identifying specific activities within each of its courses that seemed to support the academic outcomes. For example, in Calculus-I cadets are assigned daily reading assignments from the text for which they are held accountable on tests, quizzes, worksheets, and projects. Faculty members felt that this activity most directly supported outcome 1. A list of activities was developed for each of the courses

taught by the Department. In reviewing the lists of activities it became obvious that student grades on homework, projects, presentations, and exams provided one measure of success. These grades were evaluating the success of the course and students from a faculty point of view. An equally important point of view is that of the students. This lead to the development of an instrument which measures student attitudes towards the academic outcomes. This instrument measures how the students felt the courses they were taking supported the stated academic outcomes. Such an approach is consistent with that presented by Pike (1992):

> It is time for institutions to consider alternative approaches to assessing general education outcomes. The approaches will, of necessity, be institution-specific, be frequently qualitative in nature, and seek information about the effectiveness of general education programs based on faculty and student perceptions of those programs. (p. 157)

Methodology

Survey Development

Constructing Items. The course activity lists for all departmental courses were reviewed and translated into specific student objectives through a series of discussions among all faculty in the department. This process produced a list of student objectives for each of the academic outcomes by course. Since the goal was to develop an instrument that could be used for all mathematics courses, a common core of objectives present across all mathematics courses was compiled. This common core of objectives was used to develop the survey instrument. The instrument consisted of the list of objectives, along with the question, "To what extent do you think this course helps you to accomplish the following objectives?". Responses were obtained on a 5-point Likert scale ranging from Very Little to A Great Deal. In reviewing the list of objectives it became quite obvious that not all academic outcomes were equally supported by the mathematics courses. Only those outcomes for which five or more objectives had been identified were selected for inclusion in the survey. Outcome numbers, 1, 2, 3, 6 and 7, would be the constructs which the survey would be designed to measure.

Content Validity. The first step in reviewing the instrument design was to examine content validity. Content validity is meant to answer the question, *To what extent do the objectives on the instrument adequately sample from the intended universe of content?* In other words, do the identified objectives really support the stated academic outcome? The objectives (items) were randomly arranged and the 12 faculty in the Department of Mathematics were asked to identify by number the outcome which the objective supported. Those items having percent agreement of 82% or better were kept on the instrument. After completing the judgmental review process,

several outcomes had less than six objectives associated with them. In an effort to have at least six items per outcome, a focus group consisting of five mathematics faculty members convened to discuss the addition of new items, as well as how unsatisfactory items could be rewritten to better represent a particular outcome. The results of the judgmental review and focus group are summarized in Appendix A.

Sample Characteristics. After several iterations of the survey were reviewed by the mathematics faculty a final form was adopted (See Appendix B for a copy of the final instrument.) The survey was administered to 425 cadets who were taking mathematics courses during the Spring 1997 semester. The characteristics of the sampled cadets are summarized in Tables 1-5. It is important to note that a cadet taking more than one mathematics course during the spring semester would complete a survey in each course.

Table 1
Frequency Breakdown of Students by Course (n=425)

Course	Count	Percent
Calculus I	58	14
Calculus II	164	38
Calculus III	37	9
Probability & Statistics	52	12
Differential Equations	68	16
Probabilistic Models	33	8
Numerical Analysis	12	3
Missing Information	1	<1

Table 2
Frequency Breakdown of Students by Major (n=425)

Major	Count	Percent
Civil Engineering	72	17
Electrical Engineering	30	7
Mechanical Engineering	71	17
Navel Architecture	40	9
Operations Research	65	15
Marine Science	57	13
Government	54	13
Management	35	8
Missing Information	1	<1

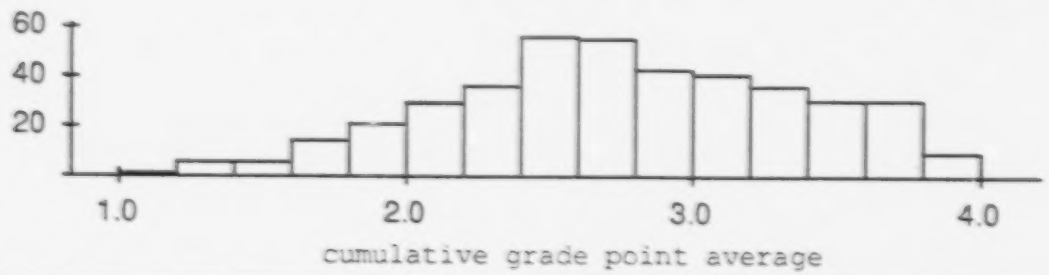
Table 3
Frequency Breakdown of Students by Gender (n=425)

Gender	Count	Percent
Female	118	28
Male	304	72

Table 4
Frequency Breakdown of Students by Class Year (n=425)

Major	Count	Percent
Senior	6	1
Junior	43	10
Sophomore	130	31
Freshman	243	57
Missing Information	3	<1

Table 5
Histogram of Cumulative Grade Point Average (n=425)



Construct Validity. The construct validity of the instrument was also examined. Construct validity answers the question, *To what extent do certain explanatory concepts explain covariation in the responses to the items on the instrument?* In other words, did the students answering the survey respond in a similar fashion to all the items that belong to a particular category (outcome). Construct validity was investigated by using Common Factor Analysis. Common Factor Analyses with both varimax and oblique rotations were conducted. The oblique rotation provided very similar results as the varimax rotation. Factor names were based on the oblique rotation,

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since it provided a clearer result in addition to providing information about the intercorrelations among the factors.

Table 6

Common Factor Analysis with Oblique Rotation: Attitude Toward Academic Outcomes in Mathematics Courses. (n=425)

Factor	Item Number	Stem	Loading
Factor I Problem Solving Outcome	20	Select one of several possible solution techniques for a given mathematical problem.	.73
	21	Break a large complex problem into a series of smaller sub-problems.	.71
	11	Infer a solution to a given problem by making use of solutions from smaller sub-problems.	.54
	2	Given several possible solution techniques for a mathematical problem select the best one.	.49
	24	Use an alternative solution technique to verify a problem solution.	.42
	12	Use course material to solve problems in many different contexts.	.41
	32	Synthesize "new" results by combining previously established results along with general mathematical principles.	.31
Factor II Writing Outcome	9	Write clear explanations of mathematical concepts as responses to short answer questions on exams.	.58
	28	Produce short written responses, in paragraph form, explaining various mathematical concepts.	.50
	22	Present written justifications of problem solutions in an understandable manner.	.47
Factor III Reading Outcome	27	Formulate questions concerning mathematical concepts from reading the textbook.	.68
	31	Read mathematical concepts in your textbook.	.66
	13	Explain a mathematical concept to a peer or instructor based on your reading of the textbook.	.63
	23	Answer questions concerning course material extemporaneously in class, based on your reading of the textbook.	.61
Factor IV Applied Learning Outcome	3	Identify real world applications of the course content .	0.83
	34	Identify how skills learned in this course will be useful to you in the future.	0.73
	16	Connect course material to information learned in other courses.	0.48
Factor V Evaluation Outcome	4	Recognize when you need to seek extra help with course material.	0.62
	5	Conduct self-assessments of your understanding of course material.	0.59
	10	Identify your strengths and weaknesses with the course material.	0.59
	38	Take notes in class which are clearly written and useful for further study.	0.37
	26	Develop successful strategies for learning the course material.	0.31

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Factor Names. The following names were given to the factors.

Factor I was named the **Problem Solving Outcome** because the items which had the highest correlations with the factor dealt with problem solving. Cadets with a high score on this scale feel that the mathematics course they are taking greatly contributes to their ability to select problem solution techniques, as well break problems up and infer a solution to the original problem based on the solutions of the smaller problems.

Factor II was labeled the **Writing Outcome** because the items which had the highest correlations with the factor dealt with being able to write responses explaining mathematical concepts, justifying solution techniques or doing evaluations. Cadets with a high score on this scale feel that the mathematics course they are taking greatly contributes to their ability to produce short written responses explaining various mathematical concepts. This includes providing written justifications for problem solutions, as well as brief evaluations about various aspects of the course.

Factor III was called the **Reading Outcome** because the items which had the highest correlations with the factor dealt with being able to read mathematical concepts from a textbook, explain mathematical concepts to peers or instructors based on reading as well as formulating questions based on reading. Cadets with a high score on this scale feel that the mathematics course they are taking greatly contributes to their ability to read and understand mathematical concepts from the textbook.

Factor IV was named the **Applied Learning Outcome** because the items which had the highest correlation with the factor dealt with being able to identify real world applications of the course content as well as how the learned material would be useful in the future. Cadets with a high score on this scale feel that the mathematics course they are taking greatly contributes to their ability to connect their learning to actual real world applications.

Factor V was labeled the **Evaluation Outcome** because the items which had the highest correlation with the factor dealt with being able to recognize when they, the cadet, needed help with the course material by monitoring their performance as well as knowing their strengths and weaknesses. Cadets with a high score on this scale feel that the mathematics course they are taking greatly contributes to their ability to monitor and evaluate their understanding of course material.

The derived factors, as noted in Appendix A, did agree with the judgmental categories which were established during the content validity phase of the study. It should be noted that there is a moderate correlation between the Problem Solving Outcome and the Applied Learning Outcome. This correlation was actually identified during the content validity phase of the instrument design. Many of the faculty members involved in the judgmental review commented

on the fact that they thought these two outcomes were very closely related. The correlations between the factors are contained in Table 7.

Table 7

Attitude Towards Academic Outcomes in Mathematics Courses Factor Intercorrelation Matrix Oblique Rotation (n=425)

	Problem Solving Outcome	Writing Outcome	Reading Outcome	Applied Learning Outcome	Evaluation Outcome
Problem Solving Outcome	1.0				
Writing Outcome	.27	1.00			
Reading Outcome	.23	.33	1.00		
Applied Learning Outcome	.49	.34	.35	1.00	
Evaluation Outcome	.39	.20	.18	.31	1.00

Item Response Analysis Results. In addition to the exploratory factor analysis the Item Response Theory Scale program was run on each of the derived factors. This program is designed to provide Rasch Latent Trait Analysis information about the scales. Maps of the items and for people for each scale are presented in Appendix C. Gable, Ludlow, & Wolf (1990) show how the variable maps from the Scale program can be used in identifying weaknesses in the construct definition. For this paper the reader should focus on the vertical line (i.e., difficulty continuum) presented in the center of the map. The upper end of the continuum would contain items most difficult to rate "A Great Deal", while the lower end would contain items that are easier to respond "A Great Deal". The construct validity issue is reflected in how well the items are spread across the continuum. A restriction in the item locations regarding the spanning of the continuum would suggest that the scale could not adequately differentiate the opinions or attributes of a high scoring person from those of a low scoring person. The maps presented in Appendix C indicate that the items on the Problem Solving Scale and the Evaluation Scale are adequately spread across the continuum that is being measured. However, the map for the Reading scale shows that there are two clusters of items, items 13 and 23 have an item value of 0.19 and items 27 and 31 have an item value of -0.16. This indicates that these four items are actually only measuring two locations on the continuum. The map for the Writing scale also has two clusters of items, items 9 and 22 have an item value of -0.24 and item 28 is spread away with an item value of 0.39. The Applied Learning scale has items 16 and 34 together with an

item value of 0.09 and item 3 has a value of -0.24, thus showing some spread. The items positioned close together will need to be examined in future investigations.

Reliability. The reliability coefficient gives an indication of the internal consistency of the responses to the items defining the scale. Reliability for the scales on this survey were calculated using the alpha internal consistency reliability coefficient. The reliability coefficients ranged from .69 for the Evaluation Outcome to .83 for the Problem Solving Outcome. In reviewing the reliability output only the Applied Learning Outcome has an item which, if deleted, would improve the reliability. The reliability information is summarized in Table 8.

Table 8

Summary of Attitude Toward Academic Outcomes in Mathematics Courses (N=425)

Factor	Item #	Response Percentages 1	2	3	4	5	Mean	Std. Dev.	Corrected Item Scale Corr.	Alpha Reliability Item deleted	Alpha Reliability
Problem Solving Outcome	20	3	11	42	37	7	3.35	.86	.63	.79	
	21	2	13	35	42	8	3.40	.89	.61	.79	
	11	2	7	35	45	11	3.55	.86	.57	.80	
	2	1	12	33	45	9	3.50	.84	.51	.81	.83
	24	4	20	45	27	4	3.07	.89	.56	.81	
	12	4	14	44	33	5	3.23	.88	.54	.81	
	32	4	13	48	31	4	3.18	1.05	.58	.80	
Reading Outcome	27	10	27	42	17	4	2.77	.98	.57	.76	
	31	11	29	37	20	3	2.76	1.00	.63	.73	.79
	13	17	28	36	15	4	2.59	1.06	.60	.74	
	23	13	34	38	14	1	2.57	.93	.61	.74	
Writing Outcome	9	7	28	41	21	3	2.85	.93	.58	.68	
	28	14	35	35	14	2	2.56	.96	.58	.68	.74
	22	6	25	44	22	3	2.89	.92	.60	.63	
Applied Learning Outcome	3	5	21	33	31	10	3.18	1.05	.62	.61	
	34	11	23	32	27	7	2.97	1.10	.63	.60	.75
	16	8	24	37	24	7	2.95	1.03	.48	.77	
Evaluation Outcome	4	3	10	29	39	19	3.62	.98	.43	.64	
	5	1	13	43	35	8	3.34	.86	.50	.62	.69
	10	1	11	33	45	10	3.52	.84	.49	.62	
	38	6	10	25	32	27	3.63	1.15	.37	.68	
	26	5	17	40	32	6	3.19	.94	.46	.63	

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Conclusion and Future Plans

Survey Evaluation. Overall the initial results of the designed instrument appear very promising. The derived constructs corresponded very well to the targeted judgmental categories. The Problem Solving scale appears to be very sound as it provided reliable data and items corresponded well with the judgmental category for Problem Solving. The other scales need to have additional items added so that the reliability can be improved. To increase reliability to .80 the Reading Scale needs to have one item added, the Writing Scale needs two items, the Learning Scale needs one additional item, and the Evaluation Scale needs four items. These new items when added to the valid items identified in this study would provide an instrument which contains a total of 30 items.

Assessment Implications. The survey presented in this paper provides two important contributions to the assessment process. First, the survey development required the Department of Mathematics to examine in detail how its courses support the published USCGA outcomes. General academic outcomes are designed to provide direction for curriculum development without prescribing specific actions. Such general direction affords academic departments flexibility in curriculum development. However, it is often difficult to know if and how specific instructional methodologies support such general outcomes. The development of survey items along with the results of the factor analysis have provided a definition of the general outcome in terms of specific course activities. For example, the Problem Solving Outcome states,

> A cadet shall be able to apply the basic skills of critical analysis, quantitative reasoning and problem solving to complex tasks in a broad range of contexts.

The survey results show that problem solving in mathematics course can be defined in terms of the following student behaviors. Cadets shall be able to:

- Select one of several possible solution techniques for a given mathematical problem;
- Break a large complex problem into a series of smaller sub-problems;
- Infer a solution to a given problem by making use of solutions from smaller sub-problems;
- Given several possible solution techniques for a mathematical problem select the best one;
- Use an alternative solution technique to verify a problem solution;
- Use course material to solve problems in many different contexts;
- Synthesize "new" results by combining previously established results along with general mathematical principles.

This operational definition of problem solving provides more specific information for use in the instructional design process.

The second contribution relates to the following statement by Hlebowitsh (1995) when he suggests

> The progressive idea of assessment in the curriculum is one that is continuous and that, in certain instances, might be an initiating activity rather than a concluding one in the conduct of curriculum improvement or reform.

In light of this definition of assessment, the survey presented in this paper will provide valuable feedback in the curriculum development process by establishing baseline assessments for each outcome. These baselines can then be used to evaluate the effects of curriculum changes relative to the published outcomes.

Future Investigations. In addition to improving the survey instrument, further investigations into differences in student attitudes by course, academic major and grade level would be appropriate. Such investigations may provide insights into the generalization of the survey instrument for use by other academic departments.

References:

Gable, R.K., Ludlow, L.H., & Wolf, M.B. (1990). The use of classical and rasch latent trait models to enhance the validity of affective measures. *Educational and Psychological Measurement*, 50, 869-878.

Hlebowitsh, P.S. (1995). A higher pragmatism: Assessment in the college curriculum. *Peabody Journal of Education*, 70, 160-174.

Pike, G.R. (1992). The components of construct validity: A comparison of two measures of general education outcomes. *The Journal of General Education*, 41, 130-159.

Appendix A

Judgmental Categories for Attitude toward Academic Outcomes in Mathematics Courses

Outcome 1:
A cadet shall be able to read and understand a variety of written materials, listen critically to oral arguments, and formulate penetrating questions.

Judgemental Review Percent Agreement	Survey Item #	Item Stem	Derived Factor
100%	6	Understand mathematical concepts from your textbook.	
100%	25	Read and understand mathematical theorems.	
100%	27	Formulate questions concerning mathematical concepts from reading the textbook.	Reading (.68)
91%	13	Explain a mathematical concept to a peer or instructor based on your reading of the textbook.	Reading (.63)
91%	30	Listen critically to oral presentations concerning mathematical concepts.	
91%	31	Read mathematical concepts in your textbook.	Reading (.66)
82%	14	Question mathematical concepts which are presented in class.	
82%	23	Answer questions concerning course material extemporaneously in class, based on your reading of the textbook.	Reading (.61)
64%	Not Used	**Read mathematical problems and represent them with appropriate mathematical notation.**	

Outcome 2:
A cadet shall be able to write clear, concise, persuasive and grammatically correct passages on general or professional topics, from a paragraph to several pages in length.

Judgemental Review Percent Agreement	Survey Item #	Item Stem	Derived Factor
100%	22	Present written justifications of problem solutions in an understandable manner.	Writing (0.47)
100%	28	Produce short written responses, in paragraph form, explaining various mathematical concepts.	Writing (.50)
91%	1	Provide a written problem solution using proper adherence to rules of logic.	
91%	9	Write clear explanations of mathematical concepts as responses to short answer questions on exams.	Writing (.58)
82%	29	Provide a written problem solution with precise use of mathematical symbols.	
55%	Not Used	**Take notes in class which are useful for understanding and applying the concepts.**	
18%	Not Used	**Study from your classnotes as you prepare for an exam.**	
9%	Not Used	**Complete homework problems using your class notes.**	
New Item added from focus group discussion	36	Write a brief evaluation about some aspect of the course, (i.e. a particular course topic or the instructor, etc.).	
Take notes item above rewritten during focus group discussion	38	Take notes in class which are clearly written and useful for further study.	Eval (.37)

Judgmental Categories for Attitude toward Academic Outcomes in Mathematics Courses

Outcome 3: .
A cadet shall be able to apply the basic skills of critical analysis, quantitative reasoning and problem solving to complex tasks in a broad range of contexts.

Judgemental Review Percent Agreement	Survey Item #	Item Stem	Derived Factor
100%	35	Prove a mathematical theorem.	
100%	37	Solve mathematical problems without having to mimic a similar problem solution.	
91%	18	Apply appropriate mathematical techniques to solve problems	
91%	21	Break a large complex problem into a series of smaller sub-problems.	Problem (.71)
91%	24	Use an alternative solution technique to verify a problem solution.	Problem (.42)
82%	11	Infer a solution to a given problem by making use of solutions from smaller sub-problems.	Problem (.54)
73%	Not Used	**Evaluate possible solution techniques for a given mathematical problem**	
64%	Not Used	**Use course material to solve problems in other courses.**	
45%	Not Used	**Solve problems in other disciplines such as physical science, management science, engineering, and social science using the course material.**	
45%	Not Used	**Discuss and justify the relative merits of different problem solving techniques.**	
Rewrite of item by focus group	2	Given several possible solution techniques for a mathematical problem select the best one.	Problem (.49)
Rewrite of item by focus group	12	Use course material to solve problems in many different contexts.	Problem (.41)
New item by focus group	20	Select one of several possible solution techniques for a given mathematical problem.	Problem (.73)

Outcome 6:
Integrate knowledge and information efficiently into a working conceptual framework that lends itself to continued expansion and refinement.

Judgemental Review Percent Agreement	Survey Item #	Item Stem	Derived Factor
91%	3	Identify real world applications of the course content .	Learning (.83)
91%	7	Use previously learned material to support new learning.	
82%	16	Connect course material to information learned in other courses.	Learning (.48)
82%	32	Synthesize "new" results by combining previously established results along with general mathematical principles.	Problem (.31)
82%	33	Understand the inter-relationship between the various mathematical concepts contained in this course.	
82%	34	Identify how skills learned in this course will be useful to you in the future.	Learning (.73)
73%	17	Explain the relationships between the major concepts covered in this course.	
64%	15	Identify the major topics contained in the course.	

Judgmental Categories for Attitude toward Academic Outcomes in Mathematics Courses

Outcome 7:
Show evidence that they (graduates) are capable of honest, realistic, and constructive self-evaluation, that they can devise successful and creative strategies to develop their strengths and correct their weaknesses, and that they demonstrate the intellectual, moral, and physical stamina to follow through..

Judgemental Review Percent Agreement	Survey Item #	Item Stem	Derived Factor
100%	5	Conduct self-assessments of your understanding of course material.	Eval (.59)
100%	8	Know how you did on an exam prior to seeing the grade.	
100%	10	Identify your strengths and weaknesses with the course material.	Eval (.59)
91%	26	Develop successful strategies for learning the course material.	Eval (.31)
54%	Not Used	**Investigate and justify the accuracy and correctness of your problem solving strategy.**	
45%	Not Used	**To know when a problem solution is incorrect.**	
9%	Not Used	**Develop an intuition about what the correct solution should be.**	
9%	Not Used	**Use an alternative solution technique to verify a problem solution.**	
New item added by focus group discussion	4	Recognize when you need to seek extra help with course material.	Eval (.62)
New item added by focus group discussion	19	Recognize when you have adequately prepared for an exam.	

Appendix B

United States Coast Guard Academy
Department of Mathematics

Course Evaluation Form

INSTRUCTIONS:

Your responses to the following survey items will be recorded on a General Purpose -NCS- Answer Sheet. Please use only a No. 2 soft lead pencil. Complete the following identifying information on the left side of the NCS Answer sheet. **Please insure that all identifying information has been properly completed with the appropriate bubbles darkened.**

- In the block titled NAME indicate your major or intended major by writing one of the below given two letter codes in the two left-most columns and darkening the appropriate bubbles.

GE - Civil Engineering	**GT** - Government
EE - Electrical Engineering	**OR** - Operations Research
ME - Mechanical Engineering	**MS** - Marine Science
NA - Naval Architecture and Marine Engineering	**MT** - Management

- In the block titled SEX indicate your gender by darkening the appropriate bubble.

- In the block titled GRADE or EDUC indicate your year group by darkening the bubble which is appropriate and corresponds to the following list.

1 - FIRST CLASS CADET
2 - SECOND CLASS CADET
3 - THIRD CLASS CADET
4 - FOURTH CLASS CADET

- In the block titled BIRTHDATE put **TODAY'S date**.

- In the block titled IDENTIFICATION starting with block A, put the 4 digit course number for the course you are enrolled in and darken the appropriate bubbles.

- In the block titled SPECIAL CODES put your current **CUMULATIVE GRADE POINT AVERAGE** and darken the appropriate bubbles. For example a cumulative GPA of 3.45 would be entered starting with block K as 345.

Indicate your responses to the following question by darkening the appropriate bubble on the NCS answer sheet which corresponds with the item number.

Appendix B (cont.)

United States Coast Guard Academy
Department of Mathematics

Course Evaluation Form

QUESTION: To what extent do you think this course helps you to accomplish the following objectives. Respond using the following scale.

A	B	C	D	E
VERY LITTLE				A GREAT DEAL

1 Provide a written problem solution adhering to proper rules of logic.

2 Given several possible solution techniques for a mathematical problem select the best one.

3 Identify real world applications of the course content.

4 Recognize when you need to seek extra help with course material.

5 Conduct self-assessments of your understanding of course material.

6 Understand mathematical concepts from your textbook.

7 Use previously learned material to support new learning.

A	B	C	D	E
VERY LITTLE				A GREAT DEAL

8 Know how you did on an exam prior to seeing the grade.

9 Write clear explanations of mathematical concepts as responses to short answer questions on exams.

10 Identify your strengths and weaknesses with the course material.

11 Produce a solution to a given problem by making use of solutions from smaller sub-problems.

12 Use course material to solve problems in many different contexts.

13 Explain a mathematical concept to a peer or instructor based on your reading of the textbook.

A	B	C	D	E
VERY LITTLE				A GREAT DEAL

Appendix B (cont.)

United States Coast Guard Academy
Department of Mathematics

Course Evaluation Form

QUESTION: To what extent do you think this course helps you to accomplish the following objectives. Respond using the following scale.

A VERY LITTLE B C D E A GREAT DEAL

14 Formulate questions about mathematical concepts presented in class.

15 Identify the major topics contained in the course.

16 Connect course material to information learned in other courses.

17 Explain the relationships between the major concepts covered in this course.

18 Apply appropriate mathematical techniques to solve problems.

19 Recognize when you have adequately prepared for an exam.

20 Select one of several possible solution techniques for a given mathematical problem.

A VERY LITTLE B C D E A GREAT DEAL

21 Break a large complex problem into a series of smaller sub-problems.

22 Present written justifications of problem solutions in an understandable manner.

23 Answer questions concerning course material extemporaneously in class, based on your reading of the textbook.

24 Use an alternative solution technique to verify a problem solution.

25 Read and understand mathematical theorems.

26 Develop successful strategies for learning the course material.

27 Formulate questions concerning mathematical concepts from reading the textbook.

A VERY LITTLE B C D E A GREAT DEAL

Appendix B (cont.)

United States Coast Guard Academy
Department of Mathematics

Course Evaluation Form

QUESTION: To what extent do you think this course helps you to accomplish the following objectives. Respond using the following scale.

A VERY LITTLE B C D E A GREAT DEAL

28 Produce short written responses, in paragraph form, explaining various mathematical concepts.

29 Provide a written problem solution with precise use of mathematical symbols.

30 Listen critically to oral presentations concerning mathematical concepts.

31 Read mathematical concepts in your textbook.

32 Synthesize new results by combining previously established results along with general mathematical principles.

33 Understand the interrelationship between the various mathematical concepts contained in this course.

A VERY LITTLE B C D E A GREAT DEAL

34 Identify how skills learned in this course will be useful to you in the future.

35 Prove a mathematical theorem.

36 Write a brief evaluation about some aspect of the course, (i.e. a particular course topic or the instructor, etc.).

37 Solve mathematical problems without having to mimic a similar problem solution.

38 Take notes in class which are clearly written and useful for further study.

A VERY LITTLE B C D E A GREAT DEAL

Appendix C

SCALE: Problem Solving Outcome

423 PERSONS 7 ITEMS MAX. OF 5 CATEGORIES 28 STEPS 05/06/97 PAGE 10

SCORE (FREQ)	PERSON POSITION	ERROR	MAP SHOWING POSITIONS OF PEOPLE AND ITEMS ON THE VARIABLE PEOPLE(N= 423) | ITEMS(L= 7)	ITEM VALUE (SE) FIT
27(3)	5.10	1.07	XXX |	
26(1)	4.26	0.81	X |	
25(6)	3.69	0.71	XXXXXX |	
24(2)	3.22	0.66	XX |	
23(6)	2.80	0.63	XXXXXX |	
22(12)	2.41	0.62	XXXXXXXXXXX |	
21(25)	2.04	0.60	XXXXXXXXXXXXXXXXXXXXXXX |	
20(25)	1.69	0.59	XXXXXXXXXXXXXXXXXXXXXXX |	
19(47)	1.35	0.58	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	
18(44)	1.02	0.57	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	
17(49)	0.70	0.56	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	
16(37)	0.40	0.55	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	I24 0.54(0.1) 0
15(41)	0.10	0.54	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	I32 0.31(0.1)-2 I12 0.22(0.1) 1
14(34)	-0.19	0.53	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX |	I20 -0.05(0.1)-2
13(21)	-0.47	0.53	XXXXXXXXXXXXXXXXXX |	I2 -0.15(0.1) 0 I21 -0.38(0.1) 1 I11 -0.49(0.1) 1
12(16)	-0.74	0.52	XXXXXXXXXXXXXX |	
11(15)	-1.01	0.51	XXXXXXXXXXXXX |	
10(10)	-1.27	0.51	XXXXXXXXX |	
9(10)	-1.53	0.51	XXXXXXXXX |	
8(4)	-1.80	0.52	XXXX |	
7(7)	-2.07	0.52	XXXXXX |	
6(5)	-2.35	0.54	XXXXX |	
5(0)	-2.65	0.56	|	
4(1)	-2.99	0.59	X |	
3(1)	-3.38	0.66	X |	
2(0)	-3.89	0.77	|	

WHEN THE SCORE GROUP POSITIONS ARE CLOSER THAN ONE TENTH OF A LOGIT, SCORE GROUPS ARE COMBINED: X=NO MORE THAN 1 PERSON/S

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Appendix C (cont.)

SCALE: Reading Outcome

409 PERSONS 4 ITEMS MAX. OF 5 CATEGORIES 16 STEPS 05/06/97 PAGE 10

MAP SHOWING POSITIONS OF PEOPLE AND ITEMS ON THE VARIABLE

SCORE (FREQ)	PERSON POSITION	ERROR	PEOPLE (N= 409)	ITEMS (I= 4)	ITEM VALUE (SE)	FIT
15(0)	3.70	1.07				
14(2)	2.85	0.82	X			
13(4)	2.27	0.72	XX			
12(18)	1.78	0.67	XXXXXXXXX			
11(20)	1.34	0.66	XXXXXXXXXX			
10(28)	0.92	0.65	XXXXXXXXXXXXX			
9(46)	0.49	0.66	XXXXXXXXXXXXXXXXXXXXXX			
8(68)	0.06	0.66	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	I13 I29	0.19(0.1)	2-2
				I27 I31	-0.16(0.1)	0-1
7(42)	-0.38	0.67	XXXXXXXXXXXXXXXXXXXX			
6(44)	-0.83	0.67	XXXXXXXXXXXXXXXXXXXX			
5(46)	-1.29	0.68	XXXXXXXXXXXXXXXXXXXX			
4(36)	-1.78	0.70	XXXXXXXXXXXXXXXX			
3(22)	-2.30	0.75	XXXXXXXXXX			
2(18)	-2.93	0.84	XXXXXXXXX			
1(8)	-3.82	1.08	XXXX			

WHEN THE SCORE GROUP POSITIONS ARE CLOSER THAN ONE TENTH OF A LOGIT, SCORE GROUPS ARE COMBINED: X=NO MORE THAN 2 PERSON/S

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Appendix C (cont.)

SCALE: Writing Outcome

416 PERSONS 3 ITEMS MAX. OF 5 CATEGORIES 12 GROUPS 05/06/97 PAGE 10

MAP SHOWING POSITIONS OF PEOPLE AND ITEMS ON THE VARIABLE

SCORE (FREQ)	PERSON POSITION	ERROR	PEOPLE (N= 416)	ITEMS (N= 3)	ITEM VALUE (SE) FIT
11(6)	3.69	1.14	XXX		
10(6)	2.67	0.92	XXX		
9(22)	1.90	0.84	XXXXXXXXXX		
8(32)	1.21	0.81	XXXXXXXXXXXXXX		
7(54)	0.57	0.79	XXXXXXXXXXXXXXXXXXXXXXXXX	I28	0.39(0.1) 0
6(78)	-0.05	0.78	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	I9 I22	-0.24(0.1) 0-2
5(72)	-0.66	0.78	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
4(62)	-1.27	0.78	XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
3(46)	-1.90	0.81	XXXXXXXXXXXXXXXXXXXX		
2(16)	-2.62	0.89	XXXXXXXX		
1(16)	-3.59	1.12	XXXXXXXX		

WHEN THE SCORE GROUP POSITIONS ARE CLOSER THAN ONE TENTH OF A LOGIT, SCORE GROUPS ARE COMBINED: X=NO MORE THAN 2 PERSON/S

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Appendix C (cont.)

SCALE: Applied Learning Outcome

416 PERSONS 3 ITEMS MAX. OF 5 CATEGORIES 12 STEPS 05/08/97 PAGE 10

MAP SHOWING POSITIONS OF PEOPLE AND ITEMS ON THE VARIABLE

SCORE (FREQ)	PERSON POSITION	ERROR	PEOPLE (N= 416)	ITEMS (I= 3)	ITEM VALUE (SE) FIT
11(16)	3.17	1.11	XXXXXXXX		
10(22)	2.23	0.87	XXXXXXXXXX		
9(34)	1.56	0.78	XXXXXXXXXXXXXXXX		
8(54)	0.99	0.73	XXXXXXXXXXXXXXXXXXXXXXXX		
7(66)	0.47	0.71	XXXXXXXXXXXXXXXXXXXXXXXXXXXX		
6(70)	-0.02	0.70	XXXXXXXXXXXXXXXXXXXXXXXXXXXX	I16 I34	0.09(0.1) 1-1
				I3	-0.24(0.1)-2
5(44)	-0.51	0.70	XXXXXXXXXXXXXXXXXXX		
4(42)	-1.02	0.72	XXXXXXXXXXXXXXXXXX		
3(32)	-1.57	0.77	XXXXXXXXXXXXXX		
2(24)	-2.22	0.85	XXXXXXXXXX		
1(8)	-3.13	1.09	XXXX		

WHEN THE SCORE GROUP POSITIONS ARE CLOSER THAN ONE TENTH OF A LOGIT, SCORE GROUPS ARE COMBINED: X=NO MORE THAN 2 PERSON/S

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Appendix C (cont.)

422 PERSONS 5 ITEMS MAX. OF 5 CATEGORIES 20 STEPS SCALE: Evaluation Outcome 05/06/91 PAGE 11

MAP SHOWING POSITIONS OF PEOPLE AND ITEMS ON THE VARIABLE

SCORE (FREQ)	PERSON POSITION	ERROR	PEOPLE (N= 422)	ITEMS (I= 5)	ITEM VALUE (SE) FIT
19(6)	3.66	1.06	XXX		
18(10)	2.83	0.80	XXXXX		
17(14)	2.27	0.69	XXXXXXX		
16(28)	1.83	0.64	XXXXXXXXXXXXX		
15(40)	1.45	0.60	XXXXXXXXXXXXXXXXXX		
14(48)	1.10	0.58	XXXXXXXXXXXXXXXXXXXX		
13(58)	0.77	0.56	XXXXXXXXXXXXXXXXXXXXXXXXX		
12(56)	0.47	0.55	XXXXXXXXXXXXXXXXXXXXXXXXXXX		
11(48)	0.18	0.54	XXXXXXXXXXXXXXXXXXXXXXXXX	I26	0.41(0.1)-2
10(28)	-0.11	0.53	XXXXXXXXXXXXXXXXXXXXX	I5	0.18(0.1)-5
9(24)	-0.38	0.52	XXXXXXXXXXXXX	I10 I4	-0.08(0.1)-4
8(24)	-0.65	0.52	XXXXXXXXXXX	I38	-0.24(0.1) 1
7(12)	-0.92	0.52	XXXXXXXXXXX		-0.27(0.1) 7
6(8)	-1.19	0.53	XXXXXX		
5(4)	-1.48	0.55	XXXX		
4(4)	-1.80	0.58	XX		
3(0)	-2.17	0.64	XX		
2(0)	-2.65	0.75			
1(0)	-3.40	1.03			

WHEN THE SCORE GROUP POSITIONS ARE CLOSER THAN ONE TENTH OF A LOGIT, SCORE GROUPS ARE COMBINED; X=NO MORE THAN 2 PERSON/S

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